MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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Dr. LEE, Vice-President, in the Chair.

The Rev. Chadwick Bates, Manchester;
Wm. Martin, Esq., 32 Aylesford Street, St. George's Square; and
A. C. Ranyard, Esq., 13 Hunter Street, Brunswick Square,
were balloted for and duly elected Fellows of the Society.

M. Léon Foucault; M. Kowalski; M. Winnecke; and Prof. G. P. Bond, were balloted for and duly elected Associates of the Society.

In the absence of the Astronomer Royal, it was announced to the Society by the Chairman, that a convention had been arranged between M. Le Verrier and the Astronomer Royal for dividing the labour of meridional observations of the Small Planets, and of the Planets generally. The peculiar form given to the agreement is determined by the special responsibilities of the Observatory of Greenwich. Since the foundation of that Observatory, incessant observations of the Moon have been considered as its most sacred object. While the meridional observations of the Moon occur in the evening, the addition of Planetary observations only adds to the labours of the Observatory in proportion to the number of observations; but,

during the observations of the morning Moon, the evening observations of Planets add a distinct labour of oppressive character. For the morning and evening meridional observations, and for the altazimuth observations, with alternations of rest to the observers, it is then necessary to allocate six observers. In order to diminish this oppression, it has been proposed by the Astronomer Royal, and most liberally agreed to by M. Le Verrier, that the Observatory of Paris should undertake the Planetary observations from Full Moon to New Moon, the Observatory of Greenwich remaining charged with those from New Moon to Full Moon.

In regard to the extent of observation of each Planet, it is understood that at the first, second, or third appearance of each Small Planet, it is to be observed as often as possible; but, with that exception, the Small Planets, and also *Uranus* and *Neptune*, are to be observed only between 10^h and 13^h solar time. The observations of *Mars*, however, are to begin when he passes at 15^h, and to be continued to quadrature, those of *Jupiter* and *Saturn* to begin at passage at 14^h and to be continued to about 8^h.

The Astronomer Royal cannot too strongly express his feelings on the zeal, the liberality, the ardour for science, and the personal kindness to himself, with which his advances have been met by M. Le Verrier.

The Astronomer Royal also thinks it a subject of congratulation that an example has been set of the combination of the efforts of different Observatories. There can be no doubt that a great amount of labour has been wasted for want of such arrangements; and if they could be further extended, the energies of many observers would be set free for important objects which hitherto have failed to receive sufficient attention.

The Astronomer Royal solicits the attention of individual observers to a request, originally circulated by himself, but now republished by M. Le Verrier in his daily *Bulletin*, to the effect that every observer, who has ascertained the error of any of the Ephemerides of the Small Planets, would immediately communicate it either to M. Le Verrier or to the Astronomer Royal. In either case it will be immediately published in the *Bulletin*. The knowledge of the amount of the error of Ephemeris very greatly facilitates the discovery and observation of the Planet with meridional instruments.

Notes on η Argus. By F. Abbott, Esq.

The anomaly connected with this remarkable Star, as to any fixed period of increase or diminution, still remains in-

explicable. Whether it will eventually disappear altogether or not is a problem yet to be solved, or whether its apparent variability is produced by changes in its own nature, or caused by other surrounding objects, is still open to discussion.

Since my former notice of this Star (April 13th, 1861) there has been a considerable diminution both in its size and light, but at no regular intervals, as will appear by the tabulated record accompanying this paper. There are circumstances, however, connected with the registering of *η Argus*, from time to time, together with the nebulous matter surrounding it, which will go far to show that not only is the Star variable, but that all the objects encircling it are subject to change.

In comparing *η Argus* with other stars it was found necessary to use more than one star of comparison, and also to consider the nature of the light at the time of comparison. Much depends upon whether the observation is made in twilight, moonlight, or starlight. *η Argus* by twilight was more difficult to find by the naked eye than any of the comparison stars; but when once it was lighted up by the surrounding Nebulæ, the eye caught it much sooner than other stars of the same magnitude.

Why it is necessary to use more than one comparison star in each observation is in case the star of comparison itself might be variable, as the following extracts from my register will illustrate.

Sept. 24th, 1861. Eve brilliant, fourteen stars, some close double well separated. By moonlight or twilight, when the nebulosity surrounding *η Argus* is destroyed, the star is identical both in size and light with λ *Centauri*.

Jan. 17th and 18th, 1862. With the Moon at full, and at the same altitude as *η Argus*, the star was still equal (by the naked eye) to 943 Lac., and λ *Centauri*, but with a low magnifying power *η Argus* was quite ruddy, as were all the stars in the vicinity.

July 2d, 1862. The star marked 943 Lac., in *Argo Navis*, is no longer a star of the 4th magnitude. In comparing *η Argus* with that star, together with *q* Lac., 11 *Argus*, *t* 1 *Argus*, and 926 *t*., all stars of the 5th magnitude, no difference could be seen.

That the duration of this Star's apparition is variable to a great extent is certain; and by comparing the present description with the monograph of Sir J. Herschel, taken at Cape of Good Hope, it will, I think, appear conclusive that the apparition of the surrounding Nebulæ is also variable.

Messier recommended careful observations to be made on such objects, with a view to ascertain whether or not any indications of change in form or structure are exhibited. That such changes have taken place is already on record. An instance is afforded by the remarkable Nebula surrounding θ

in the constellation of *Orion*, which Huyghens discovered in 1656, and noted in his *Systema Saturnium;* from comparisons of which Sir Wm. Herschel, by his own observations from 1783 to 1811, concluded it had undergone sensible change. Bouillard and Le Gentel maintained the same opinion in reference to the Nebulæ in *Andromeda;* and of later date, Bond, Pogson, Struve, D'Arrest, and others, have observed such changes.

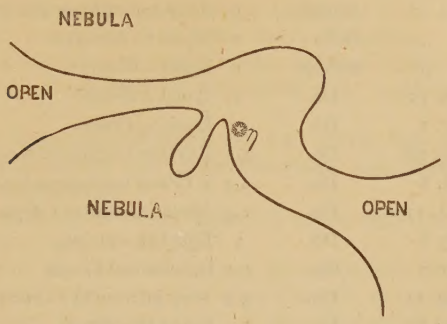
Sir John Herschel, when at the Cape, carefully examined *η Argus* with an 18-inch reflector; "No part of this Nebula," says Sir John, "shows any sign of resolution into stars." "It is not easy," he adds, "for language to convey a full impression of the beauty and sublimity of the spectacle which the Nebula offers as it enters the field of the telescope." "It will appear," he also writes, "that every succeeding state of nebulous matter is the result of the action of gravitation, and by such steps the successive condensation of it is brought to a planetary or stellar condition. Several instances are on record which connect the planetary with the stellar appearance. In those instances wherein the collection of nebulous matter was very extensive, subordinate centres of attraction could not fail to be established, around which the adjacent particles would arrange themselves, and thus the whole mass would in process of time be transformed into a determinate number of discrete bodies, which would ultimately assume the condition of a cluster of stars."

That this condition is partly carried out in the object *η Argus* will be manifest by comparing the Cape description with the present one. A great difference may be caused by the optical means employed, as far as resolvibility goes; but if an increased number of brilliant isolated stars, with a change in position of *η Argus*, is the effect produced with a 5-foot achromatic, and they were not exhibited to the same effect in an 18-inch reflector, it only strengthens the evidence in favour of some change having taken place in the object.

The open space, as given in the Cape Monograph, and also in the last edition of the *Outlines*, is somewhat in the form of a dumb-bell, compressed in the centre and surrounded with Nebulæ, in the most dense part of which is situated *η Argus*. The appearance of the open space now assumes the form of a crooked billet, wide in the centre and open at both ends, with *η Argus* situated within the open space or dark part, and surrounded with an almost innumerable quantity of brilliant stars, many of which are arranged in groups, some being of a blue, and some of a ruddy colour. They are remarkably brilliant in the dark space, and afford a good comparison with the variable Star itself.

It appears somewhat paradoxical that in 1838, when examined by Sir J. Herschel, the star *η Argus* was situated in the most dense part of the Nebula, and was seen as a star of the first magnitude. And now in 1863, it is out of the Nebula,

and within the dark space it only appears a star of the sixth magnitude.



That the star's Right Ascension has not varied so much will be manifest. It is clear then that the dense portion of the Nebula, towards the east, must have receded, leaving each end open, and *η Argus*, together with about 70 stars ± up to the 14th magnitude, as seen within the dark space.

The irregularity of this Star, and the nebulosity surrounding it, involves a principle as to whether its accession and diminution is the effect produced by distance, transits of opaque bodies or solar spots; or whether the nebulosity surrounding *η Argus* interferes with the light emitted by the star; if so, the increase and diminution, however vacillating, become obvious.

Record of Observations.

Observed Magnitudes of *η Argus*. H. 3295; Lac. 968; R.A. $10^h\ 39^m\ 45^s$; N.P.D. $148°\ 57'\ 56''$. Epoch 1863.

Year.	Month.	Observer.	Mag.	Remarks.
1677	,,	Halley	4	
1751	,,	Lacaille	2	
1811–15	,,	Burchell	4	
1822	,,	Fallows	2	
1827	,,	Burchell	1	Equal to *α Crucis*
1828	,,	Do	2.1	
1829–33	,,	Johnson	2	
1832–33	,,	Taylor	2	
1834–37	,,	Herschel	1.2	
1838	Jan. 2	Do.	1	Equal to *α Crucis*

Year.	Month.	Observer.	Mag.	Remarks.
1842	Mar. 19	Maclear	1	Inferior to *α Crucis*.
1843	April	Do.	1	Nearly equal to *Sirius*.
1843	Apr. 11	Mackay	1	Fully as bright as *Canopus*.
1850	,,	Gillis	1	Equal to *Canopus*.
1856	,,	Abbott	1	Equal *α Centauri*.
1858	Feb. 10	Do.	2	Equal *β Crucis*.
1858	Apr. 2	Do.	2	Equal *γ Crucis*.
1858	May 28	Do.	2.1	*γ Crucis* brighter of the two.
1858	Oct. 8	Do.	2.4	*γ Crucis* much superior.
1859	Mar. 27	Do.	2.5	Much inferior to *ε Argus*.
1859	July 6	Do.	3	Equal to *κ Argus*.
1860	Nov. 2	Do.	3.1	Inferior to *δ Crucis*.
1861	Mar. 21	Do.	3.5	Very inferior to *δ Crucis*.
1861	Apr. 8	Do.	4	Equal to *ε Crucis*.
1861	Apr. 13	Do.	4.1	Inferior to *ε Crucis*.
1861	June 19	Do.	5	Equal to 868 *η Argus*.
1861	June 30	Do.	5	868 *η Argus*, seen in twilight before *η Argus*.
1861	July & Aug.	Do.	4	No difference between *φ* and *η Argus*.
1861	Sept. 24	Do.	4	Equal to *λ Centauri*.
1861	Oct. 12	Do.	4	Equal to *λ Centauri*.
1861	Dec. 21	Do.	4	Equal to either *λ Centauri*, or 943 P *Argo Navis*.
1862	Jan. 17 & 18	Do.	4	Equal to *λ Centauri*, or 943 P. *Argo Navis*.
1862	Feb. 12	Do.	4	No difference from the two former, either by twilight, moonlight, or starlight.
1862	June 14	Do.	4.5	Not so large as 943 P., and larger than *q*, close stars.
1862	July 2	Do.	5	Equal to *ε Crucis*.
1862	Aug. & Sept.	Do.	5	Equal to *ε Crucis*.
1862	Nov. 14	Do.	5	For the last five months *η Argus* has not exceeded the 5th magnitude. Below the Pole, or by moonlight, it is scarcely visible as a star to the naked eye.
1863	Mar. 30	Do.	6	Equal to *z* and 977 Lac.
1863	Apr. 23	Do.	6	Fine clear night. Star in the zenith; by the naked eye scarcely recognised, as a star. With a low power it was equal to 951, 954, and 977, Lac.
1863	May 23	Do.	6	A drawing made of the object, *η Argus* quite distinct within the dark space which is open at both ends.

Private Observatory, Hobart Town,
June 1863.

On the Colours of the two Component Stars of 95 *Herculis.*

Mr. Higgens, in a letter dated Bedford, 17th August, 1863, addressed to Admiral Smyth, writes as follows:—

"I beg to forward a few notes on 95 *Herculis*.

"When I last saw the star, in the autumn of last year, the colours were as noticed in the *Cycle:* A, apple-green; B, cherry-red.

"I first saw it this year on the 23d April, but the bright hues were not there, and greenish-white and pinkish-white were all I could affirm.

"May 10th. Hues more faint. I could only record them as dull white, both A and B.

"Aug. 1st. A, greenish-white; B, yellowish: both changing nightly till Aug. 12, when they showed as in the *Cycle:* A, apple-green; B, cherry-red. A first showed signs of deepening colour, the hues becoming more apparent every night, B changing from yellow to red more rapidly.

"It was not possible to note night by night the amount of change; but it was very palpable after an interval of three or four nights, and continued so till both stars showed their normal colours.

"The instruments used were, a $3\frac{1}{4}$-inch achromatic, with 80, and a 4-inch with 115; both glasses by Cooke, of York."

Admiral Smyth remarks:—

"The star in question, 95 *Herculis*, is now a crucial instance of sidereal colour-changing; and it has given some little trouble, both to my son Piazzi and myself already, in poring over the registered observations.

"It is to be hoped that a field at once so elegant, easy, and useful, will be followed up by some of those Fellows of the Society who possess both means and leisure to pursue the interesting inquiry."

The Astronomer Royal has, however, suggested to Admiral Smyth that the simultaneous change for the two stars is suspicious, and looks like a possible change in the telescope.

On the Nebula of Orion. By Dr. Winnecke.

(*Extract from a Letter to Mr. De La Rue.*)

M. Struve's observations, published in the "Memoir on the Great Nebula of *Orion*," indicate with high probability the variability of light of some of the very feeble stars in the immediate neighbourhood of the Trapezium. Supposing that

this part of the heavens would be examined by M. Struve with the Malta Telescope, I have made, a few weeks ago, some observations on the Nebula with our Refractor. M. Struve has given (page 118 *et seq.* of his Memoir) a Catalogue of all the stars, noticed by former astronomers, which have been certainly made out with the Pulkowa Refractor. It is, therefore, very curious, that I have recently discovered five stars in the neighbourhood of the Trapezium, which are wanting in the general Catalogue mentioned above. You are acquainted with the extreme sharpness of M. Struve's eyes, and you will be with me certainly of opinion, that stars, which I measured with the micrometer, could not have been overlooked by him, had their brightness been unaltered. Still, it must be mentioned, that all these stars are to be found on Mr. Lassell's map, and probably also on the delineation of the Nebula given by Mr. Bond; a fact which I did not know when I first saw them.

The five new stars are the following:—

Comes of *h* 81	Dist. = 24″	Angle of Pos. = 107°·4
Comes of *h* 54	Position from *h* 50	115°·3
	,, from *h* 53	12°·7
Comes of *h* 75	Dist. = 9″ (est.)	Angle of Pos. = 33°·8

Two very small stars, north preceding the Trapezium; the co-ordinates of which related to the principal star θ' *Orion*, I estimate

$$\Delta\alpha = -21'', \qquad \Delta\delta = +24'',$$

and

$$\Delta\alpha = -15'', \qquad \Delta\varepsilon = +23\tfrac{1}{2}''.$$

The angle of position of the following from the preceding was measured = 91°.

I should feel very glad if you would communicate this short notice on the feeble stars to the Royal Astronomical Society.

Pulkowa, Nov. 3, 1863.

Calculation of the Sun's Parallax from the Lunar Theory.

By P. A. Hansen.

(*Translated by W. T. Lynn, Esq., of the Royal Observatory, Greenwich; Communicated by the Astronomer Royal.*)

The determination of the Solar Parallax has become lately a problem of special importance; as several investigations thereof, made in totally different manners, have given values, agreeing well among themselves, but differing considerably

from the value hitherto assumed. While, on the one hand, the Sun's Parallax had, by means of the two transits of *Venus* in the last century, been found to be = 8″·56, and this value has been generally used; on the other hand, the recent determinations, differing very little from each other, give 8″·9, or $\frac{1}{25}$th greater. Under these circumstances it is of especial interest to discover what value the Lunar Theory gives for the Solar Parallax; and this is so much the more important because its determination by means of the Lunar Theory is one of the most certain determinations of it which exists. The accuracy of the result depends principally upon the accuracy with which the coefficient of the so-called parallactic inequality can be determined by observations; and an error in this affects in a greatly diminished proportion the Sun's Parallax; for an error of 0″·1 in the determination of this coefficient produces an error of only 0″·007 in the Solar Parallax deduced from it. I have, therefore, in the elaboration of the Lunar Tables, kept this point in view, and, at the same time with the determination of the corrections of the assumed elliptic elements of the Moon's orbit, have determined the corrections of all the lunar perturbations dependent upon the Solar Parallax. That this has given me an augmentation of the hitherto assumed Solar Parallax, I have already announced in the year 1854, in the *Monthly Notices*, vol. xv. No. 1, p. 9.* In the same Periodical, vol. xxiii. No. 8, I have briefly given the Solar Parallax thus obtained; but, for the reasons mentioned above, I will here give a more accurate statement, which I extract from the manuscript of my second treatise on the calculation of the lunar perturbations, the printing of which will soon commence.

It is known that in the Moon's motion a number of inequalities arise, which are to be multiplied by the factor $\frac{a}{a'}$, that is, by the proportion of the semi-axis major of the lunar orbit to that of the Sun's orbit (Earth's orbit). The accuracy with which these inequalities can be theoretically determined, depends therefore upon the accuracy with which the value of $\frac{a}{a'}$ has previously been obtained, and the accuracy of these coefficients depends singly and alone upon this, inasmuch as all the other quantities which are used in their calculation are known beforehand with more than sufficient accuracy.

From p. 177 of my *Darlegung der theoretischen Berechnung der in den Mondtafeln angewandten Störungen*, it appears that I have assumed in that calculation,

$$\log \frac{a}{a'} = 7{\cdot}4034757,$$

* I believe that this is the first indication of the necessity of increasing the Sun's Parallax.— [G. B. A.]

and have obtained this value, by employing the hitherto-assumed Mass* of the Earth $\left[\frac{1}{354936}\right]$. The perturbations assigned in the Lunar Tables, from argument $(g' + \omega - \omega')$ to $(g - 3g' + \omega - 3\omega')$ have been calculated with attention to everything that comes into consideration, and with the above value of $\frac{a}{a'}$. These perturbations do not arise solely from the direct attraction of the Sun, but also from the effect (with changed sign) of the perturbations caused by the Moon in the motion of the Earth (or Sun); and this latter part is taken into account by multiplying the former part by the factor $\frac{M - m}{M + m}$ (M = Earth's mass, m = Moon's mass). The proof† of this theorem I have given in the *Darlegung &c.*, p. 121, &c., because Poisson has raised doubts concerning its accuracy, which appear from this to be unfounded. In p. 177 this factor is denoted by λ, and its numerical value is incorporated with the other factors, there called μ $\left[\text{or } \frac{a}{a'}\right]$ and $u_{,}^{2}$.‡ In this way has the whole of the following calculation been executed, as will be seen in detail in the second treatise, the printing of which, as already mentioned, will soon begin.

From p. 16 of the Lunar Tables there resulted, by comparison with observations, the factor

$$= 1{\cdot}03973,$$

by which it was necessary to multiply the perturbations named, in order to satisfy the observations; and in the Tables themselves, these perturbations also have been multiplied by that factor. Now, if we multiply the above value of $\frac{a}{a'}$ by this factor, we obtain

$$\log \frac{a}{a'} = 7{\cdot}4187223,$$

the value of this proportion obtained by me from the Lunar Theory, after attention to all the circumstances which come into consideration.

The mean Solar Parallax would be obtained at once from this value, by multiplying it by the value of the Lunar Parallax,

* That is, the proportion of the Earth's Mass to the Sun's Mass. As referred to mechanical units of time and space, the Earth's Mass is known with very great accuracy; and it is really the Sun's Mass, as referred to those units, which is altered by the present investigation. But in the Planetary Theory, it is convenient to assume Sun's Mass = 1; and the language of the text is accommodated to this assumption.— [G. B. A.]

† The proof is rendered extremely simple by adopting as origin of co-ordinates the centre of gravity of the Earth and Moon.— [G. B. A.]

‡ $u_{,}^{2} = \frac{\text{Sun}}{\text{Sun} - \text{Earth}} \times \left(\frac{\text{Earth's Mean Motion}}{\text{Moon's Mean Motion}}\right)^{2} \times \frac{1}{\sin 1''}$.— [G. B. A.]

corresponding to the radius vector of the Moon $r = a$; but the developments may also be so arranged that the Lunar Parallax does not appear in them at all, and this method, which is more evident and direct than the other, shall be employed here.

The equation

$$\frac{a}{a'} = \sqrt[3]{u^2} \cdot \frac{M + m}{M + m'},*$$

which has served, by substitution of the hitherto assumed value of m' ($m' =$ Sun's mass) to calculate the above given provisional value of $\frac{a}{a'}$, may now serve, by substitution of the corrected value of $\frac{a}{a'}$, to obtain the corresponding value of m'. It gives finally

$$\frac{m'}{M} = \frac{u^2 \left(1 + \frac{m}{M}\right)}{\left(\frac{a}{a'}\right)^3} - 1.$$

We have $\log u = 8{\cdot}8775917$; and if we put $m = \frac{M}{80}$, we obtain

$$m' = 319455\, M$$

for the Sun's mass, or

$$M = \frac{m'}{319455}$$

for the Earth's mass,

as deduced from the Lunar Theory. This value is considerably different from that hitherto assumed.

Let now P be the length of the simple pendulum, which would perform an oscillation in t seconds of mean time, upon the parallel where the sine of the geocentric latitude is $= \sqrt{\frac{1}{3}}$, if the centrifugal force had no existence; D the radius of the Earth at that parallel; and π the proportion of the circumference of a circle to its diameter; then it is shown by Dynamics that

$$t = \pi \sqrt{\frac{P}{k^2 \cdot \frac{M}{D^2}}};\dagger$$

and hence follows

$$k^2 M = \frac{\pi^2 P D^2}{t^2} = \frac{4 \pi^2 P D^3}{4 t^2 D}.$$

* $u = \frac{\text{Earth's Mean Motion}}{\text{Moon's Mean Motion}}$.—[G. B. A.]

† $k^2 M$, in German Physical Astronomy, corresponds to what, in English works, is usually called "the Mass," as represented by dynamical units.—[G. B. A.]

Now, if we call T′ the period of the Earth's sidereal revolution round the Sun, and n' its mean motion, we have, whatever be the fundamental units of n' and T′, $2\pi = n'\,T'$; moreover, if we call p' the mean horizontal parallax of the Sun at the same parallel, then $D = a' \sin p'$; and thus the foregoing equation is transformed into

$$k^2 M = \frac{a'^3 n'^2 T'^2 P \sin^3 p'}{4 t^2 D}.$$

But Keppler's third law gives

$$a'^3 n'^2 = k^2 (M + m'),$$

so that

$$\sin p' = \sqrt[3]{\frac{4 t^2 D M}{T'^2 P (M + m')}}.$$

This expression becomes homogeneous by expressing T′ in seconds of mean time, and expressing P and D in the same units of length. The Solar Tables give

$$T' = 31558149^s;$$

and following Bessel, I have assumed the logarithm of the equatoreal semidiameter of the Earth expressed in metres. $= 6{\cdot}8046271$. Since, moreover, the logarithm, which must be added to this, in order to obtain the log. semidiameter to the above-mentioned parallel, is $9{\cdot}9995166$,

$$D = 6370063^m.$$

For P I have always assumed the value

$$P = 0^m.992666 \frac{434{\cdot}86}{433{\cdot}86} * \text{ for } t = 1^s.$$

(See *Darlegung*, &c., p. 415.) Now, by substituting these values in the above equation, p' becomes $8{\cdot}9060$ for the parallel in question; and by reducing this to the equator, by the factor given above, the mean equatoreal horizontal Parallax of the Sun becomes $= 8''{\cdot}9159$, agreeing very nearly with the values which have been recently obtained in other ways.

* The proportion of the centrifugal force at the equator to gravity $= {\cdot}003467$; the effect in the vertical at latitude $l = {\cdot}003467 \times \cos^2 l$. When $\sin^2 l = \frac{1}{3}$, $\cos^2 l = \frac{2}{3}$, and this effect $= \frac{1}{434{\cdot}86}$ nearly.—[G. B. A.]

On the origin of the apparent luminous band which, in partial eclipses of the Sun, has been seen to surround the visible portion of the Moon's limb. By George Biddell Airy, Astronomer Royal.

Professor Challis, in his paper "On the Indications by Phenomena of Atmospheres to the Sun, Moon, and Planets," published in the *Monthly Notice* for 1863, June 12, has remarked, "if there be a lunar atmosphere, no effect would be at all likely to be discernible, except a slight condensation of solar light bordering the part of the Moon's periphery which crosses the Sun's disk." And Professor Challis then adverts to Professor Stephen Alexander's observation of such a brighter band bordering the edge of the Moon in a solar eclipse, and to the depiction of it in daguerréotypes of the eclipsed Sun.

I infer from this that Professor Challis assumes that, if a part of the Sun's disk is viewed through a refracting medium which produces an effect analogous to that of a convex lens, that part of the disk will appear brighter than the rest. It is my principal object in this paper to show, by optical investigation, that no refraction can cause a change in the apparent brightness of the surface viewed. Having regard to the astronomical importance of the subject, I think it necessary to go into the details of the investigation. I am not aware that any optical writer has examined into this question, and I present my solution nearly in the form in which I worked it out for my own satisfaction many years ago. Probably an accomplished mathematician who is familiar with the treatment of waves can exhibit the demonstration in a less cumbrous form.

My process will be this:—Assuming that a telescope of given aperture T is employed to look through the refracting medium at the Sun's disk (or any other surface), I shall ascertain the value of the pencil-angle t, of the pencil of rays emanating from any point under view, which will produce a pencil that will exactly fill the object-glass T. This is the measure of the light proceeding from any one point of the Sun. Then assuming that the field of view (or as much of it as we think fit to consider) is expressed by the visual angle σ at the object-glass, I shall ascertain the linear breadth S of so much of the Sun's disk as is seen at once in that definite field of view: this is the measure of the number of luminous points of the Sun under view. The product t S is the measure of the whole quantity of light which fills the definite field of view. And this, it is to be shown, is the same as if there were no refraction.

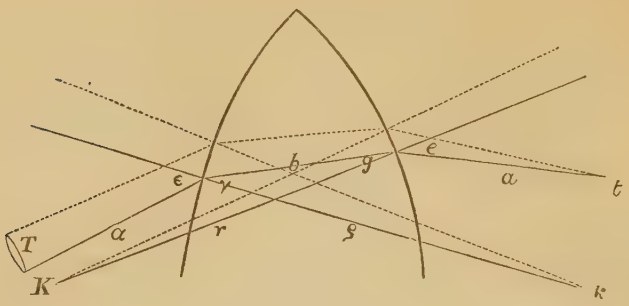


Fig. 1.

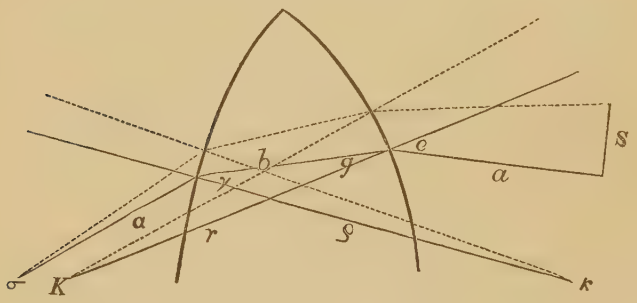


Fig. 2.

In the diagrams above, let the curved figure represent the outline of a refracting medium (the same in the two diagrams): in the first, let a pencil of light, diverging from t a point on the Sun's disk, ultimately fill the whole object-glass T; and in the second, let the axes of pencils be carried backward from the point σ of the object-glass, diverging at a definite angle σ corresponding to the definite field of view under consideration, and, after undergoing the refractions, let them include the breadth S on the Sun's disk. K and $\varkappa$ are the centres of curvature, and r and ϱ the radii of curvature, for the points of the refracting surface where the refractions take place. e is the first angle of incidence for one ray, and g the corresponding angle of internal refraction; γ the second angle of (internal) incidence, and ε its angle of refraction. For the neighbouring rays of pencil (in fig. 1), or neighbouring axes of pencils (in fig. 2), the symbol ∂ is prefixed to these letters. a, b, α are the lengths of the three portions of the broken ray.

First, let us trace the circumstances of the pencil in fig. 1.

Its transverse breadth, where it falls on the first surface, is $a\,t$.

The breadth occupied on the first surface is $\frac{a\,t}{\cos e}$.

The inclination of the two radii of curvature for the two limiting rays is $\frac{a\,t}{r\,.\cos e}$.

δe, the difference of the angles of incidence $= t + \frac{a\,t}{r\,.\cos e}$.

δg, the difference of the angles of refraction $=$

$$\frac{d\,g}{d\,e}\,.\,t\,.\left(1 + \frac{a}{r\,.\cos e}\right).$$

The inclination of the two limiting rays after the first refraction $= \delta g -$ inclination of radii of curvature $=$

$$t\left(\frac{d\,g}{d\,e} + \frac{a}{r\cos e}\,.\,\frac{d\,g}{d\,e} - \frac{a}{r\cos e}\right).$$

The transverse breadth of the pencil after the first refraction $= \frac{a\,t\,.\cos g}{\cos e}$.

After describing the path b, the transverse breadth of the pencil $=$ breadth after first refraction $+ b \times$ inclination of limiting rays $=$

$$t \times \left\{\frac{a\,.\cos g}{\cos e} + b\,.\frac{d\,g}{d\,e} + \frac{a\,b}{r\cos e}\,.\,\frac{d\,g}{d\,e} - \frac{a\,b}{r\cos e}\right\}.$$

The breadth occupied on the second surface is

$$t \times \left\{\frac{a\,.\cos g}{\cos\gamma\,.\cos e} + \frac{b}{\cos\gamma}\,.\,\frac{d\,g}{d\,e} + \frac{a\,b}{r\,.\cos\gamma\,.\cos e}\,.\,\frac{d\,g}{d\,e} - \frac{a\,b}{r\,.\cos\gamma\,.\cos e}\right\}.$$

The inclination of the two radii of curvature for the limiting rays is

$$t \times \left\{\frac{a\,.\cos g}{\varrho\,.\cos\gamma\,.\cos e} + \frac{b}{\varrho\,.\cos\gamma}\,.\,\frac{d\,g}{d\,e} + \frac{a\,b}{\varrho\cos\gamma\,.\,r\cos e}\,.\,\frac{d\,g}{d\,e} - \frac{a\,b}{\varrho\cos\gamma\,.\,r\cos e}\right\}.$$

$\delta\gamma =$ inclination of radii $-$ inclination of limiting rays after the first refraction.

$$\delta\varepsilon = \frac{d\,\varepsilon}{d\,\gamma} \times \left\{\begin{array}{c}\text{inclination of radii} - \text{inclination of limiting}\\ \text{rays after the first refraction.}\end{array}\right\}$$

The inclination of the two limiting rays after the second refraction $=$ inclination of radii $-\delta\varepsilon = \left(1 - \frac{d\,\varepsilon}{d\,\gamma}\right) \times$ inclination

of radii $+ \frac{d\varepsilon}{d\gamma} \times$ inclination of limiting rays after the first refraction =

$$t \times \left(1 - \frac{d\varepsilon}{d\gamma}\right) \times \left\{ \frac{a \cos g}{\varrho \cos \gamma \cdot \cos e} + \frac{b}{\varrho \cos \gamma} \cdot \frac{dg}{de} + \frac{ab}{\varrho \cos \gamma \cdot r \cos e} \cdot \frac{dg}{de} - \frac{ab}{\varrho \cos \gamma \cdot r \cos e} \right\}$$

$$+ t \times \left\{ \frac{d\varepsilon}{d\gamma} \cdot \frac{dg}{de} + \frac{a}{r \cos e} \cdot \frac{d\varepsilon}{d\gamma} \cdot \frac{dg}{de} - \frac{a}{r \cos e} \cdot \frac{d\varepsilon}{d\gamma} \right\}.$$

The transverse breadth of the pencil after the second refraction = breadth on second surface $\times \cos \varepsilon =$

$$t \times \left\{ \frac{a \cdot \cos \varepsilon \cdot \cos g}{\cos \gamma \cdot \cos e} + \frac{b \cos \varepsilon}{\cos \gamma} \cdot \frac{dg}{de} + \frac{ab \cdot \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e} \cdot \frac{dg}{de} - \frac{ab \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e} \right\}.$$

And the ultimate transverse breadth of the pencil (which hereafter is to be made = T) is = breadth after second refraction $+ \alpha \times$ inclination of limiting rays after second refraction =

$$t \times \left\{ \frac{a \cdot \cos \varepsilon \cdot \cos g}{\cos \gamma \cdot \cos e} + \frac{b \cos \varepsilon}{\cos \gamma} \cdot \frac{dg}{de} + \frac{ab \cdot \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e} \cdot \frac{dg}{de} - \frac{ab \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e} \right\}$$

$$+ t \times \left(1 - \frac{d\varepsilon}{d\gamma}\right) \times \left\{ \frac{\alpha a \cos g}{\varrho \cos \gamma \cdot \cos e} + \frac{\alpha b}{\varrho \cos \gamma} \cdot \frac{dg}{de} + \frac{\alpha ab}{\varrho \cos \gamma \cdot r \cos e} \cdot \frac{dg}{de} - \frac{\alpha ab}{\varrho \cos \gamma \cdot r \cos e} \right\}$$

$$+ t \times \left\{ \alpha \cdot \frac{d\varepsilon}{d\gamma} \cdot \frac{dg}{de} + \frac{\alpha a}{r \cos e} \cdot \frac{d\varepsilon}{d\gamma} \cdot \frac{dg}{de} - \frac{\alpha a}{r \cos e} \cdot \frac{d\varepsilon}{d\gamma} \right\}.$$

Let the entire factor of t in the last expression be called V. Then we must have $t \times \mathrm{V} = \mathrm{T}$, or $t = \frac{\mathrm{T}}{\mathrm{V}}$.

Secondly, let us trace the circumstances of the diverging axes of pencils in fig. 2.

The investigation is in every respect similar, and the form of the result is precisely similar, with due changes of symbols. We find $\sigma \times \mathrm{W} = \mathrm{S}$, where W may be formed from V by putting α for a and a for α, ε for e and e for ε, γ for g and g for γ, ϱ for r and r for ϱ; b occupies the same place in both formulæ.

And, this being done, the quantity of light which comes to

the eye in a definite portion of the field of view, or ιS, will $= \frac{T}{V} \times \sigma \times W = T\sigma \times \frac{W}{V}$. As T and σ are given, by the construction of the telescope, the quantity of light which comes to the eye in a definite portion of the field of view is proportional to $\frac{W}{V}$.

It does not appear possible to assign any value to this fraction until we have assigned the proper forms to the differential coefficients which occur in the expressions. To do this, let $\sin e = n \cdot \sin g$ (according to the received law of refraction); then $\cos e = n \cdot \cos g \cdot \frac{dg}{de}$, or $\frac{dg}{de} = \frac{1}{n} \cdot \frac{\cos e}{\cos g}$. Similarly $\frac{d\varepsilon}{d\gamma} = n \cdot \frac{\cos \gamma}{\cos \varepsilon}$. Substituting these, V becomes =

$$\frac{a \cdot \cos \varepsilon \cdot \cos g}{\cos \gamma \cdot \cos e} + \frac{b \cdot \cos \varepsilon}{\cos \gamma} \cdot \frac{1}{n} \cdot \frac{\cos e}{\cos g} + \frac{a\,b \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e} \cdot \frac{1}{n} \cdot \frac{\cos e}{\cos g} - \frac{a\,b \cdot \cos \varepsilon}{r \cdot \cos \gamma \cdot \cos e}$$

$$+ \left(1 - n \frac{\cos \gamma}{\cos \varepsilon}\right) \times \left\{ \frac{\alpha a \cos g}{\varrho \cos \gamma \cdot \cos e} + \frac{\alpha b}{\varrho \cos \gamma} \cdot \frac{1}{n} \cdot \frac{\cos e}{\cos g} + \right.$$

$$\left. \frac{\alpha a b}{\varrho \cos \gamma \cdot r \cos e} \cdot \frac{1}{n} \cdot \frac{\cos e}{\cos g} - \frac{\alpha a b}{\varrho \cos \gamma \cdot r \cos e} \right\}$$

$$+ \frac{\alpha \cos \gamma \cdot \cos e}{\cos \varepsilon \cdot \cos g} + \frac{\alpha a \cdot \cos \gamma}{r \cdot \cos \varepsilon \cdot \cos g} - n \frac{\alpha a \cdot \cos \gamma}{r \cos e \cdot \cos \varepsilon};$$

which will be more easily understood if we divide it into three separate classes of terms, and arrange the individual terms as below: —

Terms of V independent of n:

$$\frac{\alpha a \cdot \cos g}{\varrho \cos \gamma \cdot \cos e} + \frac{a \alpha \cos \gamma}{r \cos g \cdot \cos \varepsilon}$$

$$- \frac{\alpha a \cdot b}{\varrho \cos \gamma \cdot r \cos e} - \frac{a \alpha \cdot b}{r \cos g \cdot \varrho \cos \varepsilon}$$

$$- \frac{\alpha \cos e \cdot b}{\varrho \cos \varepsilon \cdot \cos g} - \frac{a \cos \varepsilon \cdot b}{r \cos e \cdot \cos \gamma}$$

$$+ \frac{\alpha \cos \gamma \cdot \cos e}{\cos \varepsilon \cdot \cos g} + \frac{a \cos g \cdot \cos \varepsilon}{\cos e \cdot \cos \gamma}.$$

Terms of V multiplying n:

$$\frac{\alpha a \,.\, b}{\varrho \cos \varepsilon \,.\, r \cos e}$$

$$- \frac{\alpha a \,.\, \cos g}{\varrho \cos \varepsilon \,.\, \cos e} - \frac{\alpha a \,.\, \cos \gamma}{r \cos e \,.\, \cos \varepsilon}.$$

Terms of V multiplying $\frac{1}{n}$:

$$\frac{\alpha \cos e \,.\, b}{\varrho \cos \gamma \,.\, \cos g} + \frac{a \cos \varepsilon \,.\, b}{r \cos g \,.\, \cos \gamma}$$

$$+ \frac{\alpha a \,.\, b}{\varrho \cos \gamma \,.\, r \cos g}$$

$$+ \frac{\cos \varepsilon \,.\, \cos e \,.\, b}{\cos \gamma \,.\, \cos g}.$$

Now, as has been said, we are to form W from V by interchanging a and α, e and ε, g and γ, r and ϱ. But on proceeding to do this, we shall see immediately that each line of the expression, as last arranged, is strictly symmetrical with regard to these quantities, and therefore the interchange produces no alteration whatever in it; and, consequently, $W = V$; and the light which comes into a definite portion of the field of view of the telescope $= T\sigma \times \frac{W}{V} = T\sigma$, or is exactly the same as if no refracting medium were interposed.

And therefore refraction by a lunar atmosphere cannot explain the more luminous band which appears to surround the Moon's limb where it crosses the Sun's disk.

I have no difficulty in explaining to myself the origin of the luminous band in question. It is strictly an ocular nervous phenomenon, not properly subjective, but sensational—a mere effect of contrast. I have seen it so frequently under circumstances very different from these, that I cannot have the smallest doubt on the matter.

A person who stands before a moderately illuminated whitish wall, and swings a piece of black cloth upwards between his eye and the wall, will almost always see the edge of the black cloth preceded by a broad luminous band. I should once have said that such a band is always seen, but I find that I do not see it so conspicuously now as formerly. The continuous decay of the nervous irritability of the retina is, I believe, an ordinary physiological fact. When I used to

see it best, its angular breadth, as measured by the visual angle at the eye, was not less than two degrees. This I believe to be the sole and sufficient explanation of the phenomenon in question, both in the eye-view of the material Moon and in the eye-view of the photographs of the Moon. In the latter case, as I understand, the explanation is substantiated by Mr. De La Rue's experiments.

Royal Observatory, Greenwich,
1863, *Sept.* 5.

On the Extension of Lunar Nomenclature. By W. R. Birt, Esq.

During the course of my lunar inquiries, I have met with several craters, some of very considerable size, and other portions of the Moon's surface, that have been destitute of names, and in a few instances have not even been delineated on our maps. Taking the large map of Beer and Mädler, as one of our principal lunar authorities, I have, in conjunction with Dr. Lee — who suggested to me the importance of distinctly designating such portions of the Moon's surface, as contributing greatly to the advance of Selenography — named those which up to this time appeared sufficiently prominent to merit the distinction. Some of these names are already before the public, and a few may be found for the first time in the following list. As it is not improbable that these names may be retained by astronomers, both Dr. Lee and I have thought it advisable to make this communication to the Society, that they may be permanently recorded in its Archives.

It will be desirable to record, with the names of these lunar spots, their selenographical Longitudes and Latitudes, and also to carry on the numbering adopted by the Rev. T. W. Webb, in his little, but useful work, *Celestial Objects for Common Telescopes.*

Recently-named Lunar Craters, &c.

I. *North-West Quadrant.*

		Lat.	Long.
405	The Coxwell Mountains	10° N. to 15° N.	45° W.
406	Mount Glaisher	15° N.	46° W.
407	Chevallier	45° N.	50° W.
408	Moigno	63° N.	25° W.
409	Peters	68° N.	25° W.

II. *North-East Quadrant.*

410	The Teneriffe Mountains	41° N. to 48° N.	3° E. to 18° E.
411	Piazzi Smyth	42° N.	3° 30′ E.
412*	Herschel II.	58° N. to 64° N.	30° E. to 40° E.
413*	Robinson	58° N. to 63° N.	40° E. to 50° E.
414*	South	55° N. to 58° N.	45° E. to 53° E.
415	Babbage	57° N. to 62° N.	52° E. to 60° E.

III. *South-East Quadrant.*

416	The Percy Mountains	17° S. to 25° S.	41° E. to 53° E.
417*	Rosse	53° S. to 60° S.	48° E. to 55° E.

IV. *South-West Quadrant.*

418	J. Franklin	12° 30′ S. to 18° 30′ S.	47° W. to 52° W.
419	Crozier	15° S.	50° W.
420	M'Clure	15° S.	48° W.
421		13° S.	49° W.
422	Wrottesley	23° S.	56° W.
423	Phillips	24° S. to 27° S.	73° W. to 80° W.
424*	The Mare Smythii	5° 30′ N. to 9° S.	80° W. to 95° W.

The authority for the above co-ordinates is Beer and Mädler's map; they, however, require a careful redetermination.

Hartwell Observatory, Nov. 12, 1863.

On certain Depressions on the Moon's Western Limb.

By the Rev. Henry Cooper Key.

Although it has long been known that many depressions from the general level of the Moon's surface are to be found upon her disk, and that some of these depressions are of large extent, probably much beyond anything of the same kind existing on the Earth, if we except the beds of our oceans and seas, still this singular circumstance has no doubt attracted the attention of many observers that the depressions in question seem to be confined to the interior portion of the Moon's disk, and that none are visible on the limbs during any part of her libration. I speak of depressions of large area—not of comparatively small gullies, lying between elevated ranges, which

* Those marked * are unrepresented in Beer and Mädler's large map, but some very imperfect indications of them exist.

are constantly to be seen projected on the limb, but of vast tracts, the general level of which lies very considerably beneath the mean level of the Moon's surface.

I have lately had the good fortune to witness the projection on the limb of the Moon of several of these tracts of large area, the largest of which extended across more than 35° of latitude, and its deepest depression below the general level of the Moon's surface could hardly be less than twenty-five miles. These amounts are merely rough estimates, but will probably be found to be within rather than beyond the truth.

Having mounted my new 12-inch glass speculum, I had for some time past been making experiments with it, in the unsilvered state, upon celestial objects, with the view of ascertaining how far a diminution of light and consequently of the evils of irradiation, combined with a large aperture, might be an advantage in particular cases. For this purpose, on the 20th of September, at about 6 P.M., before the Sun had set, I turned the telescope upon the Moon, then a few hours past her first quarter. I had no sooner focussed the telescope (power 120), than I was astounded at observing that the limb of the Moon was entirely *out of shape;* that it was, in fact, irregularly polygonal, as if several large segments had been cut off the spherical limb — not the terminator. Of course I at once changed the eye-piece (using powers of 85 and 203), and looked to see whether the instrument was out of adjustment, but the cause of this extraordinary appearance was clearly not in the telescope.

The accompanying diagram,* drawn from recollection the following day, is, I am sorry to say, the only representation I am able to exhibit; and this merely indicates, in a rough man-

* The letters *a*, *b*, and *c* stand opposite to the middle of the depressions respectively.

ner, the position of these large areas of depression. It did not occur to me, at this time, that libration and bad weather combined might prevent my making drawings and measurements another night: I looked upon the feature as a permanent one, the details of which I could secure at any time.

From the absence of all irradiation, the limb of the Moon was far more beautifully defined than I ever saw it before; and one or two mountains stood up in wonderfully clear relief on the north-western limb, in the neighbourhood, I think, of *Strabo*.

The same evening, at about 8 P.M., I verified these appearances with an excellent 8-inch (silvered glass speculum) Newtonian. They were evident enough, but not nearly so much so as in the larger instrument, two hours before: indeed I felt satisfied that I should not have noticed them had they not been pointed out in so glaring a manner by the larger unsilvered speculum.

Having written to my friend the Rev. T. W. Webb, of Hardwick, upon the subject, on the following day, Sept. 21st, enclosing him a diagram, I received a letter from him on the 25th Sept., in which he says: "I had not the least recollection, from your diagram, where to look for the flattenings, and, to say the truth, was not prepossessed in their favour, thinking they might have arisen from optical imperfection; or rather, as you used two telescopes, from irregular atmospheric refraction. At any rate, I was perfectly free from the expectation of seeing them; but, with a power of 64, there they were *at once*." And in a later letter, dated Sept. 30th, he says: "There is no doubt whatever about your depressions. I tried them with the micrometer, and the immediate presence of the wire proved beyond the possibility of doubt that they were actually flat; one was a little concave. . . . . The flattenings must be very extensive, as I found them unaffected by a considerable amount of libration."

In the meantime, owing to the painters being at work, I was unable to use my large instrument until Friday Sept. 25th. I then made preparation for taking correct alignments, &c., so as to fix the positions of these depressions with something like accuracy; but to my great disappointment, on turning the instrument upon the Moon, I found that, with the exception of a comparatively faint trace, they had entirely disappeared; the Moon's limb presenting its usual uniform curve. Nor during the present lunation have I been able (from the 15th to the 23d of October) to detect any but the slightest trace of them. I ought to state, however, that during the interval the speculum had been silvered.

The appearance of these flat surfaces was so extraordinary (they are hardly at all exaggerated in the diagram) that, had not my own observations been fully confirmed by those of Mr. Webb, I should hardly have ventured to make public mention

of them. But as there can now be no doubt whatever about their existence, I trust some close observer of the Moon will search for them, and before long find them again, and fix their positions accurately.

From a still later communication from Mr. Webb I am led to think, that, although he undoubtedly saw these flattenings, and was able to fix the position in latitude of some of them pretty clearly, yet that he did not see anything like the same extraordinary effect that I witnessed at 6 P.M. on Sept. 20th, when the Moon's limb was altered in shape in so surprising a manner. The depressions which he observed, and which required close scrutiny from the first, he was able to keep in view for some days after, and even remarked them during the present lunation, up to Oct. 22d; whereas the astonishing appearance of the Moon's limb which I noticed at 6 P.M. on the 20th of Sept., was so completely gone on Friday the 25th Sept. that I turned away disappointed, and did not stop to examine the faint traces which were still remaining.

My conclusion therefore is,—in the first place,—that the maximum of visibility of these depressions lasts but a short time, probably not more than forty-eight hours at the most, or from three to four days after the greatest south-east libration; that in the absence of some means for annihilating the evils of irradiation at the Moon's limb, the full extent of them is not readily to be seen, and would not easily be credited; that the chances of their being noticed with ordinary instruments, by any one who was not previously aware of their existence, are very small indeed; and that it is entirely to these circumstances that their present accidental discovery is to be attributed.

The effect of irradiation in obliterating the true outline of an object, and unduly enlarging its diameter or extent, is shown in a striking manner by the fact that a piece of platinum wire of the thickness of a very fine hair, when intensely heated by the voltaic current, so as to become extremely luminous, immediately appears to be as thick as coarse bell-wire. Another obvious instance, and very *àpropos*, is to be seen in the young Moon, when the unillumined portion of her disk is visible; owing to irradiation, that part which is illumined by the Sun's rays appears to be a portion of a considerably larger circle than that which bounds the rest of the disk. It ought not then to surprise us, to find that the strong irradiation at the Moon's limb affects her outline to a very serious extent, even sufficiently to obliterate inequalities subtending an angle of many seconds.

To Sir John Herschel belongs the credit of first suggesting the use of plain glass specula in the Newtonian telescope for observing the Sun; and I am convinced from my own experience already that additional information will be obtained respecting the nature of the Sun's surface by this means. But their use should not by any means be confined to the Sun;

wherever the brilliance of an object is sufficient, I strongly advocate the use of the plain in addition to the silvered speculum; for instance, upon large fixed stars, and the planets *Mars*, *Jupiter*, *Saturn*, and especially *Venus*. The delicate pencilling on the surface of the planet *Jupiter* is brought out by this means with marvellous effect; the diminished light of course increases the effect of the darker markings; while at the same time the eye, being less stimulated by the brighter portions, is able to expand with comfort, and to discern stipplings and shade of exceeding faintness, the existence of which could not even be suspected in an ordinary instrument of equal aperture. The effect on the planet *Saturn* is quite stereoscopic; the light of the ball being so strongly contrasted with that of the rings, that the body of the planet seems, as it were, isolated and suspended within the rings, in a far more marked manner than in an ordinary instrument. But more especially should advantage be taken of the total absence of irradiation, obtainable by this means, to observe the occultations both of fixed stars and planets by the Moon, as being the most likely method of obtaining more trustworthy evidence respecting her atmosphere.

Stretton Rectory, Hereford,
Nov. 3, 1863.

Observations of Venus, made near her Inferior Conjunction.
By Capt. W. Noble.

On Monday, the 28th of September, I examined the planet, when she was from $6^h\ 36^m$ to $6^h\ 20^m$ from her inferior conjunction. The apparent tenuity of her crescent was very striking; the cusps were perceptibly fainter than the middle of the limb. I did not attempt to measure the width of the illuminated portion, but did obtain a few micrometrical measurements of the distance between her cusps, and the mean of these gave it as $61''{\cdot}3068$. The diameter of the planet given in the *Nautical Almanac* for that day being $59''$, I did not look for the dark body of the planet; but from what I subsequently observed on Friday, the 9th of October, have no doubt that proper precautions would have enabled me to see the whole of the limb at the time of her inferior conjunction.

Forest Lodge, Maresfield,
12th Nov., 1863.

Observations of Venus at the Inferior Conjunction.

By C. Leeson Prince, Esq.

Although *Venus* was not favourably situated for observation at the time of inferior conjunction last month, yet, as I took some interest in watching the planet almost daily from the 23d to the 30th, both inclusive, the following remarks may perhaps be interesting to those who have been similarly engaged:—

"Sept. 23d. Observing *Venus* to-day just about the time of meridian passage, I *thought* I saw the whole disk slightly illuminated; but as the atmosphere was in a very disturbed state, I could not be quite certain.

"25th. Upon looking at the planet again to-day, I am satisfied that I not only saw the dark body, but also a phosphorescent flitting of light around the edge of the entire disk. Notwithstanding the stormy weather, the very narrow illuminated portion was well seen.

"26th. The dark body of the planet seen again to-day, but not so distinctly as yesterday.

"27th. Planet not seen well to-day, the atmosphere being very tremulous. Dark body of the planet not seen, but there were glimpses of light around the edge of the disk, as observed on 25th.

"28th. A very stormy morning, with driving rain. No opportunity occurred of looking at the planet until 2 P.M., when I observed that there had been no appreciable difference in the breadth of the illuminated portion since 25th; but the horns of the crescent had lessened, and did not extend to a semidiameter of the planet. The dark body was faintly seen. Diameter of planet, measured with Jones's double-image micrometer, 58″·7.

"30th. As the planet passed the meridian to-day, I again observed the phosphorescent flitting of light around the *edge* of the disk, which I had observed both on 25th and 27th; but I could not see the dark body of the planet which I noticed on 23d, 25th, 26th, and 28th."

From this date stormy wet weather prevented any further observations till Oct. 6, at which time the dark body of the planet was no longer visible, and the horns of the crescent were still less than a semidiameter of the planet.

P.S. I had almost forgotten to mention that I always saw the above phenomenon best by using a power of 150 with Dawes' solar eye-piece and $\frac{1}{8}$-inch diaphragm.

Uckfield, Oct. 17th, 1863.

On the Occultation of κ Cancri by the Moon on the 26th April, 1863. By C. Leeson Prince, Esq.

My attention having lately been called to the letter of the Rev. W. R. Dawes in the *Monthly Notices*, vol. xxiii. p. 251, respecting the occultation of *κ Cancri* by the Moon on April 26th, I am induced to send the copy of a memorandum which I have found in my Observatory-book respecting that phenomenon, inasmuch as it confirms Mr. Copeland's observation, and points to the advantages of observing these phenomena with telescopes of considerable aperture.

"April 26th. *κ Cancri* occulted by the Moon at $12^h\,3^m\,32^s{\cdot}5$. The disappearance was *not* instantaneous by fully half a second."

About an hour previously I had watched the disappearance of *Jupiter's* second satellite, when I noticed that the satellite appeared projected upon the planet for at least thirty seconds before its disappearance. At the time I attributed both phenomena to some peculiar state of our atmosphere. The day had been cloudless; barometer (reduced) at 9 A.M., 30·358; wind N.W. The telescope employed was of 6·8 inches aperture, and 12 feet focal length; power 150.

Uckfield, Oct. 17th, 1863.

In reference to the same Occultation, the Astronomer Royal has communicated an observer's note, which should have been sent with the observations, as printed *Monthly Notices*, t. xxiii. p. 248.

The observer's (Mr. Creswick's) note runs as follows:—

"The star did not seem to disappear with the suddenness I have generally noticed."

Mr. Creswick's impression is, that there was a loss of light at about one-tenth of a second before the final disappearance. Mr. Creswick is certain that, at Greenwich, there was no great loss of light five-tenths of a second before the final disappearance.

Observations of the Sun at Rising to Determine the Refraction; and of Solar Spots. By Sir Andrew Lang.

I take leave to forward a few more observations on the rising of the Sun, at my position, for deducing the Refraction. I could have wished to have made many more, but long intervals will occur before you can obtain a sight of the Sun rising from

the horizon of the sea, from beds of cirri prevailing at the horizon, rendering it impossible.

Professor Drew, in his valuable work on Meteorology, says the cumulus is formed only in the daytime. This is certainly not the case in the West Indies, where the cumulus prevails as much at night as during the day, forming a continuous stream of cloud, floating at a height of about two thousand feet above the level of the sea.

The *solar tides of the atmosphere* are as regular as clock-work, rising and falling every six hours.

4 to 10 A.M. rising; 10 A.M. to 4 P.M. falling.
4 to 10 P.M. rising; 10 P.M. to 4 A.M. falling.

Any disturbance therein, especially during our hurricane months, is a certain sure warning to be vigilant and suspicious of the weather.

Some observations made at my position, in the Island St. Croix (Lat. 17° 44′ 32″ N., Long. 64° 41′ W. from Greenwich), on the Sun's centre rising from the horizon of the sea, to determine the Refraction.

Place of observation 440 feet above the level of the sea; angle of depression of the sea horizon 20′ 56″.

	Refraction and Parallax.	Barometer.	Therm. Fahr.
	′ ″		°
1860, June 5	32 5·15	29·567	77·4
6	32 20	·602	77
9	32 4·20	·646	77·2
10	32 4	·58	76
24	32 2·4	·57	77
27	32 10·8	·67	78·6
1861, May 25	32 38·6	·36	76
July 19	32 24·7	·61	77
27	32 28·8	·62	79·3
28	32 30	·65	78·5
Aug. 1	32 19	·62	77
1863, May 21	32 10·2	·708	77
June 5	32 12	·610	73·6
9	32 12	·682	78
22	32 4·2	·700	76·5
29	32 1·0	·646	76
July 9	32 12	·660	76
11	32 12	·646	77
Mean of the 18 Observations	32 14	29·631	76·94

More correctly it should be stated that, for my own convenience, the above eighteen observations have been made at my dwelling, 3″ South of my Observatory there, in Lat. 17° 44′ 29″ N., Long. the same, 64° 41′ West. Height of the eye above the level of the sea 420 feet, and angle of depression of horizon of sea 20′ 26″.

Some remarks regarding the Sun, which I examine, I may say, every morning, when at an altitude of 15° to 20°, and note the appearance of any new spot, cluster, or chain.

In 1862 my number of these is 148; in 1861, as already reported, 226; and in 1860, 274.

1862, June 10. A connected chain of spots on disk, about 120,000 English miles in length.

July 23 to Aug. 3. A monster black spot observed, about 35,000 English miles in diameter.

Sept. 24. Two parallel chains of spots, about 180,000 English miles in length each.

Oct. 8, 9. Two beautiful chains of spots, vertical, close to each other, near the centre, about 100,000 English miles in length each.

Nov. 22. A splendid chain of spots, about 140,000 English miles in length.

Dec. 31. A large cluster of spots, No. 148, the last number for the year.

1863, April 1. An immense chain of spots for several days; must be noticed in Europe.

Aug. 24 to Sept. 9. Not a spot on disk; an extraordinary occurrence.

Sept. 9. A small spot, No. 9, and a small chain, No. 91, disappear; dissipated on the 12th.

Sept. 12 to 22. Not a spot on disk.

Sept. 23. A large spot comes on upon Limb, No. 92.

Sept. 29. A great cluster just come on, No. 93.

Oct. 3. No. 93 has now become a connected chain of spots, with a large black spot at each extremity, 90,000 English miles in length.

Oct. 4. No. 99 has disappeared by rotation; No. 94, a small spot, just come on.

St. Croix, West Indies, Oct. 4, 1863.

Elements and Ephemeris of Comet IV. 1863.

By M. Hermann Romberg.

(*Communicated by G. Barclay, Esq.*)

This Comet was discovered on Oct. 9, in R.A. $9^h\ 36^m$, Decl. $+29°$, by Mr. Bäcker, at Nauen. From two observations taken at Leipsic and one at Vienna, viz.:—

1863.	G.M.T. h m s	Comet's R.A. ° ′	Comet's Decl. ° ′ ″
Oct. 11	13 25 43	146 41 18·3	+30 22 7·3
14	13 35 14	149 1 53·7	31 24 0·9
16	15 3 40	150 43 4·0	+32 8 22·9

I calculated the following parabolic elements, taking into account the small corrections of Parallax and Aberration:—

T 1863, Dec. 27·70863 Greenwich M.T.

	° ′ ″	
π	180 17 53·4	Apparent Equinox
Ω	104 51 28·8	of Oct. 14.5.
i	+ 82 16 29·4	
log q	0·131934	

Direct.

The errors of the mean place being

C − O $\quad \Delta\lambda = -12''{\cdot}7 \quad \Delta\beta + 2''{\cdot}3$

From these elements I calculated the following Ephemeris, giving the place of the Comet with sufficient exactness:—

0^h Gr. 1863.	Comet's R.A. h m s	Comet's Decl. ° ′	Log Δ.	Bright.
Nov. 6	11 30 46	+40 25·7	0·1864	2·35
8	11 42 7	41 15·7	·1783	
10	11 54 3	42 4·4	·1705	
12	12 6 36	42 51·4	·1631	
14	12 19 45	43 35·7	·1562	2·89
16	12 33 31	44 16·9	·1499	
18	12 47 51	44 54·3	·1441	
20	13 2 44	45 27·1	·1390	
22	13 18 6	45 54·7	·1344	3·39
24	13 33 53	46 16·3	·1306	
26	13 49 59	46 31·7	·1276	
28	14 6 17	46 40·1	·1254	
30	14 22 41	46 41·8	·1239	3·72
Dec. 2	14 39 1	46 36·2	·1232	
4	14 55 15	46 23·9	·1233	
6	15 11 11	46 4·8	·1242	
8	15 26 45	45 39·7	·1258	3·90
10	15 41 50	45 8·7	·1281	
12	15 56 25	44 32·7	·1310	
14	16 10 23	43 52·6	·1345	
16	16 23 46	+43 8·6	0·1387	3·72

The brightness of the Comet on Oct. 9 taken $=1\cdot00$. The Comet will probably not become visible by the naked eye.

Observatory of G. Barclay, Esq.
Leyton, 1863, Nov. 8.

New Minor Planet (79), *discovered by James Watson, Director of the Observatory of Ann Arbor.*

The original observations were

		R.A.	Decl.
	h m	h m s	° ′
1863, Sept. 14	16 25	1 0 35	+9 56·7
15	10 2	1 0 14	+9 52·2

The Planet was of the 10th magnitude. Observations, Oct. 4, at Leipsic, and Oct. 6, at Vienna, are published, *Ast. Nach.*, Nos. 1440 and 1441; and the observations, from Sept. 14 to Sept. 23, by Mr. Watson, at Ann Arbor, *Ast. Nach.* No. 1442, where the following elements are given:—

Epoch 1863, Sept. 19 Greenwich M.T.

$$M = 333^\circ\ 50'\ 17''\cdot8$$
$$\varpi = 45\ 35\ 56\cdot0 \quad \Omega = 206\ 37\ 17\cdot4 \quad \text{Mean Equinox } 1863\cdot0.$$
$$i = 4\ 38\ 27\cdot1$$
$$\varphi = 11\ 19\ 25\cdot1$$
$$\log a = 0\cdot388320$$
$$\log \mu = 2\cdot967527$$
$$\mu = 927''\cdot955$$

A communication has been received from Prof. J. Zech, of Tübingen, containing the Statutes of the Astronomical Society founded at Heidelberg on the 28th of Aug. 1863. The Society is declared to be a union of astronomers and friends of astronomy, with a view to the advancement of that science, particularly in the carrying out of such works as require a systematic co-operation of many persons. Above all the Society aim at the drawing up, with united strength and according to uniform principles, of elements of reduction and auxiliary tables for the effective execution of the preliminary labours which many investigations require. The Society seeks also to promote, by seasonable support, in important

investigations, the co-operation of several labourers, or the means of enabling individuals to devote themselves to such for several years. The business language is German, but the membership is limited to no nationality. The seat of the Society, as the place of meeting, and of issue of its publications, is at first Leipsic. The Council is as follows:—

J. Zech, Professor at Tübingen, President.

F. Argelander, Professor at Bonn.

O. Struve, Director of the Observatory at Pulkova.

C. Bruhns, Professor at Leipsic, Vice-President.

E. Schönfeld, Professor at Mannheim, Secretary.

W. Förster, Dr., Observer at the Berlin Observatory, Secretary.

J. Zöllner, Dr., at Leipsic, Treasurer.

All the members of the Council are prepared to receive declarations from persons desirous of joining the Society.

Rectification.

Mr. Howlett writes, that by an error on his part, it is stated on page 267, fifth line from the top, in the supplementary *Monthly Notice*, vol. xxiii. No. 9, that the divided glass diaphragm employed in his record is ruled off into $\frac{1}{100}$ths of an inch. It is really ruled off into $\frac{1}{200}$ths.

RECENT PUBLICATIONS.

Positiones Mediæ Stellarum fixarum in Zonis Regiomontanis a Besselio inter +15 et +45 Declinationes observatarum ad annum 1825 reductæ et in Catalogum ordinatæ, auctore Maximiliano Weisse, Directore quondam Speculæ Cracoviensis. Jussu Academiæ Imperialis Petropolitanæ edi curavit et præfatus est Otto Struve Speculæ Pulcovensis Director. 4to. Petropoli, 1863.

The title is a sufficient explanation of the contents of this Catalogue, a continuation of the former Catalogue, extending from Decl. $-15°$ to $+15°$, edited by W. Struve in 1846.

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